MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

PEM0036 – CALCULUS

(Foundation in Engineering)

18 OCTOBER 2016
2.30 p.m. - 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **FOUR (4) pages** including cover page and appendix with **FOUR (4) questions** only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided. All necessary working **MUST** be shown.
4. Only non-programmable calculator is allowed.

QUESTION 1 [25 marks]

(a) For $f(x)=\dfrac{3-\sqrt{x^2-27}}{x+6}$, find the following:

(i) $\lim_{x\to L} f(x)$ (1 mark)

(ii) $\lim_{x\to\infty} f(x)$ (3 marks)

(iii) $\lim_{x\to -6} f(x)$ using simplification method (5 marks)

(iv) $\lim_{x\to -6} f(x)$ using L'Hopital's Rule. (4 marks)

(b) Refer to **Figure 1** below:

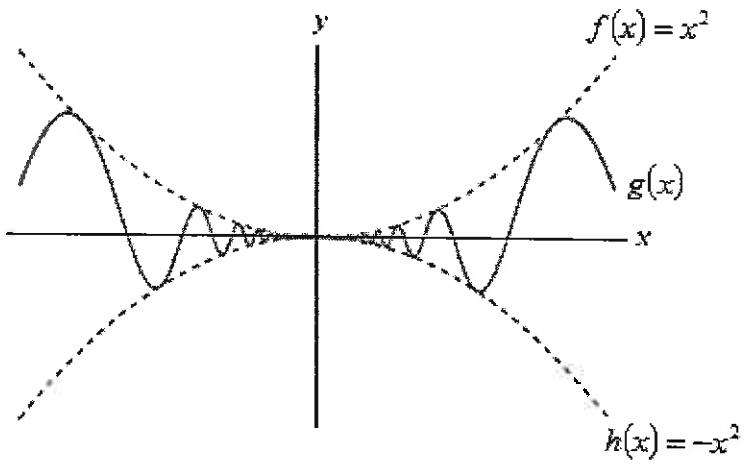

Figure 1

Do the following:

(i) Show that $\lim_{x\to 0} g(x)$ exist using Squeeze Theorem. (3 marks)

(ii) Show that $\lim_{x\to 7} g(x)$ cannot be determined using Squeeze Theorem. (3 marks)

(c) Verify whether $f(x)=\begin{cases} x^2+2 & x\le 1 \\ -x+4 & x\ge 1 \end{cases}$ continuous at $x=1$. (6 marks)

QUESTION 2 [25 marks]

For function $f(x)=2x(16-x^2)^{1/2}$, find the following:

(a) Domain for the function. (3 marks)

(b) Normal line equation for the function at $x=2$. (7 marks)

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(c) Extreme value(s) and where they occur. (7 marks)

(d) Inflection point(s). (8 marks)

QUESTION 3 [25 marks]

Graph for $f(x)=(25-x)^{1/3}$ and $g(x)=-(25-x)^{1/3}$ are as plotted in the **Figure 2** below:

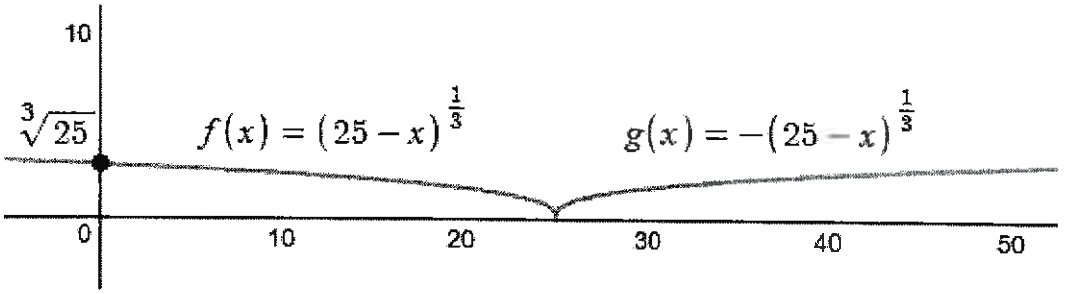

Figure 2

Do the following:

(Round up any fractions/roots up to 3 decimals throughout the computation)

(a) Use volume by disk method to evaluate the volume if the region in the interval of $[0, 25]$ is revolved about the $y-$axis. (5 marks)

(b) Use shell method to verify your answer in (a). (7 marks)

(c) Use volume by washer method to evaluate the volume if the region in the interval of $[25, 50]$ is revolved about the $y=10$. (8 marks)

(d) Use shell method to verify your answer in (c). (5 marks)

QUESTION 4 [25 marks]

Solve the following differential equations:

(a) $\sqrt{x}\,\dfrac{dy}{dx}-e^{2y+\sqrt{x}}=0$ (5 marks)

(b) $x\dfrac{dy}{dx}+4y-8=\dfrac{1}{x}$

(Express your answer as an explicit equation) (9 marks)

(c) $y''+10y'+21y=0;\quad y(0)=19;\quad y'(0)=-4$ (11 marks)

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APPENDIX

BASIC DIFFERENTIATION AND INTEGRATION FORMULAS

$$\frac{d}{dx}[\sin x] = \cos x \qquad \frac{d}{dx}[\cos x] = -\sin x$$

$$\frac{d}{dx}[\tan x] = \sec^2 x \qquad \frac{d}{dx}[\sec x] = \sec x \tan x$$

$$\frac{d}{dx}[\cot x] = -\csc^2 x \qquad \frac{d}{dx}[\csc x] = -\csc x \cot x$$

$$\frac{d}{dx}[e^x] = e^x \qquad \frac{d}{dx}[\ln x] = \frac{1}{x} \;;\quad x > 1$$

$$\frac{d}{dx}[sin^{-1}x] = \frac{1}{\sqrt{1-x^2}} \qquad \frac{d}{dx}[cos^{-1}x] = -\frac{1}{\sqrt{1-x^2}}\ for -1 < x < 1$$

$$\frac{d}{dx}[tan^{-1}x] = \frac{1}{1+x^2} \qquad \frac{d}{dx}[cot^{-1}x] = -\frac{1}{1+x^2}\ for -\infty < x < \infty$$

$$\frac{d}{dx}[sec^{-1}x] = \frac{1}{|x|\sqrt{x^2-1}} \qquad \frac{d}{dx}[csc^{-1}x] = -\frac{1}{|x|\sqrt{x^2-1}}\ \ for|x| > 1$$

$$\int \tan u\, du = \ln|\sec u| + C \qquad \int \sec u\, du = \ln|\sec u + \tan u| + C$$

$$\int \cot u\, du = \ln|\sin u| + C \qquad \int \csc u\, du = -\ln|\csc u + \cot u| + C$$

$$Area = \int_a^b [f(x) - g(x)]\ dx$$

$$Volume\ (Disk) = \pi \int_a^b [f(x)]^2\ dx$$

$$Volume\ (Washer) = \pi \int_a^b [f(x)]^2 - [g(x)]^2\ dx$$

$$Volume\ (\ Cylindrical\ Shells) = \int_a^b 2\pi(shell\ radius)(shell\ height)\ dx$$

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